Remarks:

Applicants have read and considered the Office Action dated July 13, 2011 and the references cited therein. Claims 1 and 30 have been amended. Claims 1-3, 6-13, 15-25, 28-31, 33, 34, 36-38 and 40-42 are currently pending. Reconsideration is hereby requested.

Claims 1, 3, 9-10, 12-13, 15, 17-20, 23-25, 28-31, 37-38 and 41-42 were rejected under 35 U.S.C. §103(a) as being unpatentable over Takahashi (US 5,522,789) in view of Suzuki (US 5,796,427). Applicants respectfully traverse the rejection. Claims 1 and 30 have been amended and patentably distinguish over the combination of Takahashi and Suzuki or any other prior art or combination thereof.

The present invention relates to a stereoscopic endoscopic system and method for producing stereoscopic color images of an object while compensating for movements of the image sensor assembly (e.g., as a result of human operator hand movements). The system of the present invention includes an image sensor assembly, a movement detector and a processing unit. The processing unit is coupled with the sensor assembly and with the movement detector.

The sensor assembly acquires a sequence of alternative stereoscopic images of an object. For example, the sensor assembly acquires a first right side image of the object (i.e., an image acquired from a right side perspective), a first left side image of the object (i.e., an image acquired from a left side perspective), a second right side image of the object, a second left side image of an object, a third right side image of the object, and so forth (See the paragraph beginning on page 45, line 15 and the paragraph beginning on page 48, line10). The movement detector detects movements of the sensor assembly in a plane perpendicular to the optical axis of the sensor assembly and produces corresponding movement signals (See page 46, lines 21-29).

The processing unit receives the detected stereoscopic images from the sensor assembly

and receives movement signals from the movement detector, respective of the sensor movements (i.e. movement data). The processing unit selects corresponding portions of the alternating stereoscopic images for producing a sequence of stereoscopic display images. It is noted that for producing stereopsis (i.e., producing depth perception) the display images must show the same area of the object from different perspectives. Therefore, the corresponding portions of the stereoscopic images are sub-matrices of the stereoscopic images that have the same area size (i.e., the same size) and which show the same area of the object. That is, the processing unit selects a sub-matrix of each of the detected stereoscopic images, **such that all the sub-matrices have the same area size and show the same area of the object** (See Figures 26-27 and page 47, lines 1-9, and page 50, line 23-page 51, line 17).

The sub-matrices are selected for compensating for the movements of the sensor assembly. Therefore, the processing unit selects the corresponding portions of the alternating stereoscopic images (i.e., the sub-matrices), according to the received movement data. In particular, the processing unit selects each sub-matrix, from its respective stereoscopic image, according to the relative displacement of the sensor assembly while acquiring the respective stereoscopic image from a point of origin. The point of origin is defined by the average of the movements of the sensor assembly. In case the average point of the sensor movements changes and is not constant, a new point of origin is defined. Thereby, the processing unit selects a sequence of stereoscopic sub-matrices all showing the same area of the object. (See the paragraphs beginning on page 46, line 3; page 47, line 1; page 47, line 19; and at page 48, line 1).

Takahashi

Takahashi describes a stereoscopic endoscopic imaging apparatus. The system of Takahashi includes a pair of relay lens systems, an imagery optical system and a pair of imaging devices. The imagery optical system is a verifocal optical system. The system detects

movements of elements within the verifocal optical imagery system and accordingly moves the image detectors.

The present invention is directed at producing stereoscopic endoscopic images while compensating for movements of the sensor assembly, which are perpendicular to the optical axis of the sensor assembly. Takahashi fails to teach or even suggest compensating for movements of the sensor assembly as a result of, for example, the movements of the hand of the operator. This was stated in section 4 (page 3) of the Office Action:

> "*Takahashi fails to disclose a movement detector for detecting movements of the sensor assembly perpendicular to the optical axis, relative to the object, and compensating for detected movements of the stereoscopic sensor assembly ...*"

Therefore, Takahashi cannot be considered as disclosing or even suggesting the present invention and merely describes a stereoscopic system.

Suzuki

Suzuki describes an image stabilizer as known in the art (See: the background and Figures 3-4 of Suzuki), including a field memory, a memory controller and a fluctuation detector (See Suzuki, column 1, lines 17-25). The fluctuation detector produces information respective of the fluctuation of an image pickup device and notifies the memory controller (See Suzuki, column 2, lines 3-8). The memory controller identifies an area common to the first and second images on the basis of this notification (See Suzuki: column 2, lines 8-16). After the memory controller identifies the common area, the memory controller reads only image information representing the common area and accordingly produces a new image (i.e., a display image) (See Suzuki, column 2, lines 17-24).

As the common area is smaller than the originally detected images, since a fluctuation was

detected by the image pickup device, producing a new image having the same area of the originally detected images from less image information. Producing such an image in this manner inevitably reduces the image quality. This is shown explicitly in Figure 4 of Suzuki where section A1, which represents the area common to the first and second images F1 and F2 respectively, but which is clearly smaller than either of those images, is used to produce a new image F3. Image F3 has the same area as images F1 and F2 but is generated from section A1, which is clearly smaller and has less image information. This is the problem of the prior art image stabilizer that Suzuki aims to overcome and is stated explicitly in Suzuki as follows:

> "*When the common area is identified, the memory controller reads only an image information representing the common area. In this case, the memory controller is set to have, for example, a long reading period so that a third image may be built by means of only this image information (a less amount of information than usual). After that, the image information is converted into a recording signal by the D/A converter.*
>
> *In the above-mentioned existing image stabilizer, there has been a problem in the amount of image information for representing an image to be recorded, although compensation of a fluctuation is performed, in case that a fluctuation of an image pickup device, namely, a fluctuation of an image happens. In other words, there has been a problem that quality of an image represented by a recording signal is deteriorated.*" (See Suzuki: column 2, lines 17-32, *emphasis added*)

Suzuki's solution to the above problem of the prior art is to supplement the image information of the identified common area between a pair of consecutive images, with image information taken from the first image of the pair of consecutive images, thereby improving the quality of the display image (See Figure 2 of Suzuki and the accompanying description). As shown in Figure 2 of Suzuki, the new image F_{out} includes the portion A1, which was common to F_{new} and F_{old}, as well as a portion A2 from F_{old}, which was supplemented to F_{out}.

Therefore, both the prior art image stabilizer and the Suzuki image stabilizer identify the common area without applying any limitations to the identified common area. That is, the common area between consecutive images is not necessarily common throughout a sequence of consecutive images. For example, the common area between a first image and a second image could show a first area of the object while the common area between the second image and a third image could show a second area of the object that does not coincide with the first area of the object. Additionally, the common area could be of any size and is dependent on the movement of the image pickup device between consecutive images. It can be seen that the size of the common area may significantly change between consecutive images. Moreover, the Suzuki solution of appending image information from a previous image to the common area might adversely affect the integrity of the image created from the common area. For example, in case the object itself is also moving between consecutive images, the appended area would present the object in a first stance while the common area would present the object in a second stance, different than the first stance.

Conversely, the system of the present invention detects a sequence of stereoscopic images and selects from the sequence corresponding portions (i.e., sub-matrices) for producing a sequence of stereoscopic display images. Thus, as required for producing stereopsis, the selected sub-matrices must show the same area of the imaged object and have the same area size. This limitation is recited in claim 1 of the present invention as follows:

> "*wherein said processing unit selects corresponding portions of said alternating stereoscopic images, according to a signal received from said movement detector and compensates for detected movements, thereby producing a visually stable sequence of display images,*
>
> *and wherein said visually stable sequence of display images comprises a plurality of sub-matrices, each one of said sub-matrices is selected from a respective one of said*

stereoscopic images, each one of said sub-matrices is located at a distance equal to a respective one of said movements from said location of origin, in a direction opposite to said respective movement, relative to said location of origin." (*Emphasis added*)

Therefore, when the average point (i.e., of the sensor movements – the location of origin) changes, the system of the present invention determines a new average point. The new average point is determined for enabling the system of the present invention to select sub-matrices that show the same area of the object and that have the same area size. Otherwise (i.e., without determining a new average point), sub-matrices showing the same area of the object would have to be smaller. It can be appreciated that as each sub-matrix is located at a distance equal to a respective sensor movement from the point of origin, the area size of the sub-matrix decreases as the distance from the point of origin increases. As recited in claim 1, the average movements of the sensor assembly must be constant to maintain a uniform size for each sub-matrix:

"*the average of said movements being constant and defining a location of origin*

...

and wherein said visually stable sequence of display images comprises a plurality of sub-matrices, each one of said sub-matrices is selected from a respective one of said stereoscopic images, each one of said sub-matrices is located at a distance equal to a respective one of said movements from said location of origin, in a direction opposite to said respective movement, relative to said location of origin." (Emphasis added)

As detailed herein above, Suzuki cannot be considered as disclosing the present invention and in particular as disclosing or even suggesting selecting corresponding portions of the detected images as stereoscopic display images (i.e., sub-matrices having the same area and showing the same area of the object of the detected images). Therefore Suzuki cannot correct the deficiencies of Takahashi.

The combination of Takahashi and Suzuki

As detailed herein above, Takahashi fails to disclose or suggest a method for compensating for movements of the sensor assembly (perpendicular to the optical axis of the sensor), and Suzuki fails to correct the deficiencies of Takahashi. A combined system of Takahashi and Suzuki would include the stereoscopic endoscope of Takahashi complemented by the fluctuation compensation system of Suzuki. Such a combined system compensates for movement of the image detector of the stereoscopic endoscope between two consecutive images by identifying a common image area and producing from that common image area a display image, having the area size of the detected images. Additionally, the common image area between a first pair of consecutive images does not necessarily show the same area of the object as the common image area between a second pair of consecutive images, thereby blurring the stereoscopic display images.

The combined system cannot thus be considered as disclosing the present invention, in particular the stereoscopic device recited in claim 1. In addition, none of the other cited prior art publications describe selecting corresponding portions of the detected stereoscopic images as stereoscopic display images for compensating for the movements of the sensor.

The arguments presented herein above with respect to claim 1 apply *mutatis mutandis* to independent claim 30 and Applicants assert that claim 30 patentably distinguishes over the prior art for similar reasons. As independent claims 1 and 30 are new, novel and non-obvious over the combined teachings of Takahashi and Suzuki (and any other cited prior art or combination thereof), the dependent claims also patentably distinguish over the prior art.

Claims 2 and 33 were rejected under 35 U.S.C. §103(a) as being unpatentable over Takahashi and Suzuki in view of Adelson (US 5,076,687). Adelson fails to remedy the

shortcomings of the Takahashi and Suzuki combination. Therefore, Applicants assert that claims 1 and 30 patentably distinguish over the combination of Takahashi, Suzuki and Adelson. As claims 1 and 30 patentably distinguish over the combination of Takahashi, Suzuki and Adelson, Applicants assert that claims 2 and 33 patentably distinguish over the combination for at least the same reasons. Applicants therefore request that the rejection under 35 U.S.C. §103(a) be withdrawn.

Claim 36 was rejected under 35 U.S.C. §103(a) as being unpatentable over Takahashi, Suzuki and Adelson in view of Watanabe (US 5,812,187). Watanabe fails to remedy the shortcomings of the Takahashi, Suzuki and Adelson combination. Therefore, Applicants assert that claims 1 and 30 patentably distinguish over the combination of Takahashi, Suzuki and Adelson. As claim 30 patentably distinguish over the combination of Takahashi, Suzuki and Adelson, Applicants assert that claim 36 patentably distinguishes over the combination for at least the same reasons. Applicants therefore request that the rejection under 35 U.S.C. §103(a) be withdrawn.

Claims 6, 8, 11, 16, 21-22 and 40 were rejected under 35 U.S.C. §103(a) as being unpatentable over Takahashi and Suzuki in view of Watanabe. Watanabe fails to remedy the shortcomings of the Takahashi and Suzuki combination. Therefore, Applicants assert that claims 1 and 30 patentably distinguish over the combination of Takahashi, Suzuki and Watanabe. As claims 1 and 30 patentably distinguish over the combination of Takahashi, Suzuki and Watanabe, Applicants assert that claims 6, 8, 11, 16, 21-22 and 40 patentably distinguish over the combination for at least the same reasons. Applicants therefore request that the rejection under 35 U.S.C. §103(a) be withdrawn.

A speedy and favorable action in the form of a Notice of Allowance is hereby solicited. If the Examiner feels that a telephone interview may be helpful in this matter, please contact Applicants' representative at (612) 336-4728.

Please consider this a PETITION FOR EXTENSION OF TIME for a sufficient number of months to enter these papers or any future reply, if appropriate. Please charge any additional fees or credit overpayment to Deposit Account No. 13-2725.

23552
PATENT TRADEMARK

Respectfully submitted,

MERCHANT & GOULD P.C.

Dated: 12/13/11

By: _____
Gregory A. Sebald
Reg. No. 33,280
GAS/krn